

LISTING OF CLAIMS:

The following Listing of Claims supercedes all previous claims listings. Claim 1 is amended hereby, claims 28-33 are newly presented, and claims 2 and 4, which depend from claim 1, are original claims; claims 3, 5-8 and 10-27 were previously withdrawn, and claim 9 has been previously cancelled.

1. (Currently Amended) An apparatus for traction positional control comprising:
a hauling unit that hauls a subject to bend or rotate the subject;
a control unit that outputs a control signal, wherein

the control signal corresponds to a target value that is input by an operating unit, and

the control unit controls a first variation amount of the control signal of the control signal output in a predetermined range including a position of the hauling unit in a state before the hauling unit hauls the subject to be greater than a second variation amount, the first variation amount being included in the control signal that lies within a predetermined range, the second variation amount being included in the control signal that lies outside the predetermined range, the predetermined range relative to a tension of the hauling unit in a state before the hauling unit hauls the subject of the control signal output outside the predetermined range; and

- a driving unit that drives the hauling unit based on the control signal.

2. (Original) The apparatus according to claim 1, wherein the control unit outputs the control signal based on the target value, wherein the target value is either of an amount of bending and an amount of rotating of the subject.

3. (Withdrawn) The apparatus according to claim 1, wherein the control unit outputs the control signal based on the target value, wherein the target value is either of a speed of bending and a speed of rotating of the subject.

4. (Original) The apparatus according to claim 1, wherein the control unit determines the control signal by compensating the target value based on a predetermined parameter.

5. (Withdrawn) The apparatus according to claim 1, wherein the control unit determines the control signal by compensating the target value based on a parameter, and the control unit renews the parameter based on a state parameter of the hauling unit.

6. (Withdrawn) The apparatus according to claim 5, wherein the state parameter is a tension of the hauling unit.

7. (Withdrawn) The apparatus according to claim 1, wherein the control unit determines the control signal by multiplying the target value by a variable gain, and the control unit renews the variable gain based on a state parameter of the hauling unit.

8. (Withdrawn) The apparatus according to claim 7, wherein the state parameter is a tension of the hauling unit.

9. (Cancelled)

10. (Withdrawn) An apparatus for traction positional control comprising:
a hauling unit that hauls a subject to bend or rotate the subject;
an output unit that outputs an operation command value signal that corresponds to a target value that is input by an operating unit;
a feedforward control unit that compensates the operation command value signal based on a feedforward compensation value, and generates a feedforward control signal;
a drive control unit that generates a control signal based on the feedforward control signal; and

a driving unit that drives the hauling unit based on the control signal.

11. (Withdrawn) The apparatus according to claim 10, further comprising:
a drive detecting unit that detects a driving state of the driving unit; and
a first deviation calculating unit that calculates a first deviation between the feedforward control signal and a detecting signal detected by the drive detecting unit, wherein the drive control unit generates the control signal in such a way that the first deviation is suppressed to zero.

12. (Withdrawn) The apparatus according to claim 10, further comprising:
a plurality of hauling units that are coupled to each other, and transmit a driving force from the driving unit in succession;
a relay drive detecting unit that detects a relay driving state when one of the hauling units receives the driving force from another hauling unit, and outputs a relay state signal;

a relay deviation calculating unit that calculates a deviation between the feedforward control signal and a detecting signal detected by the relay drive detecting unit; and

a relay control unit that suppresses the deviation to zero, wherein
the drive control unit generates the control signal based on a signal output from
the relay control unit.

13. (Withdrawn) The apparatus according to claim 10, further comprising:
a hauling state detecting unit that detects a hauling state of the hauling unit, and
outputs a hauling state detecting signal;
a second deviation calculating unit that calculates a second deviation between the
operation command value signal and the hauling state detecting signal;
a feedback control unit that generates a feedback control signal to suppress the
second deviation to zero; and
a signal generation unit that generates a compensation signal that is obtained by
compensating the feedforward control signal using the feedback control signal, and outputs the
compensation signal to the drive control unit.

14. (Withdrawn) The apparatus according to claim 13, wherein the hauling state
detecting unit comprises
a tension detecting unit that detects a tension of the hauling unit;
a state estimating unit that estimates a state of the subject based on the operation
command value signal and the tension; and
a dynamics changing unit that changes dynamics of the feedforward control unit
and dynamics of the feedback control unit based on a result of the state estimating unit.

15. (Withdrawn) An apparatus for traction positional control comprising:
a hauling unit that hauls a subject to bend or rotate the subject;

an output unit that outputs an operation command value signal that corresponds to a target value that is input by an operating unit;

a feedforward control unit that compensates the operation command value signal based on a feedforward compensation value, and generates a feedforward control signal;

a drive control unit that generates a control signal based on the feedforward control signal;

a correction control unit that controls a variation amount of the control signal output in a predetermined range including a position of the hauling unit in a state before the hauling unit hauls the subject to be greater than a variation amount of the control signal output outside the predetermined range; and

a driving unit that drives the hauling unit based on the control signal.

16. (Withdrawn) The apparatus according to claim 15, further comprising:

a hauling state detecting unit that detects a hauling state of the hauling unit, and outputs a hauling state detecting signal;

a deviation calculating unit that calculates a deviation between the operation command value signal and the hauling state detecting signal;

a feedback control unit that generates a feedback control signal to suppress the deviation to zero; and

a signal generation unit that generates a compensation signal that is obtained by compensating the feedforward control signal using the feedback control signal, and outputs the compensation signal to the drive control unit.

17. (Withdrawn) The apparatus according to claim 16, wherein the hauling state detecting unit comprises

a tension detecting unit that detects a tension of the hauling unit;
a state estimating unit that estimates a state of the subject based on the operation command value signal and the tension; and
a dynamics changing unit that changes dynamics of the feedforward control unit and dynamics of the feedback control unit based on a result of the state estimating unit.

18. (Withdrawn) The apparatus according to claim 15, wherein the correction control unit outputs the control signal based on the target value, wherein the target value is either of an amount of bending and an amount of rotating of the subject.

19. (Withdrawn) The apparatus according to claim 15, wherein the correction control unit outputs the control signal based on the target value, wherein the target value is either of a speed of bending and a speed of rotating of the subject.

20. (Withdrawn) The apparatus according to claim 15, wherein the correction control unit determines the control signal by compensating the target value based on a predetermined parameter.

21. (Withdrawn) The apparatus according to claim 15, wherein
the correction control unit determines the control signal by compensating the target value based on a parameter, and
the correction control unit renews the parameter based on a state parameter of the hauling unit.

22. (Withdrawn) The apparatus according to claim 15, wherein the state parameter is a tension of the hauling unit.

23. (Withdrawn) The apparatus according to claim 15, wherein
the correction control unit determines the control signal by multiplying the target
value by a variable gain, and
the correction control unit renews the variable gain based on a state parameter of
the hauling unit.

24. (Withdrawn) The apparatus according to claim 23, wherein the state
parameter is a tension of the hauling unit.

25. (Withdrawn) The apparatus according to claim 1, wherein the hauling unit is a
wire.

26. (Withdrawn) The apparatus according to claim 1, wherein the operating unit is
a joystick.

27. (Withdrawn) The apparatus according to claim 1, wherein the driving unit is a
motor.

28. (New) The apparatus according to claim 4, wherein the predetermined
parameter is set manually in accordance with degree of extension of the hauling unit.

29. (New) The apparatus according to claim 1, further comprising:

a notch filter through which the control signal output from the control unit passes
to gradually change a differential value of the control signal with respect to the target value near
a boundary between inside the predetermined range and outside the predetermined range, and
output the control signal to the driving unit.

30. (New) The apparatus according to claim 1, further comprising:

a low pass filter through which the control signal output from the control unit passes to gradually change a differential value of the control signal with respect to the target value near a boundary between inside the predetermined range and outside the predetermined range, and output the control signal to the driving unit.

31. (New) The apparatus according to claim 1, wherein the hauling unit is a wire.

32. (New) The apparatus according to claim 1, wherein the operating unit is a joystick.

33. (New) The apparatus according to claim 1, wherein the driving unit is a motor.